United States
Environmental Protection
Agency

Research and Development

Risk Reduction
Engineering Laboratory
Cincinnati, OH 45268

EPA/600/S-95/006 April 1995

EPA

ENVIRONMENTAL RESEARCH BRIEF

Waste Minimization Assessment for a Steel Fabricator

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Abstract

The U.S. Environmental Protection Agency (EPA) has funded a pilot project to assist small and medium-size manufacturers who want to minimize their generation of waste but who lack the expertise to do so. Waste Minimization Assessment Centers (WMACs) were established at selected universities and procedures were adapted from the EPA *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003, July 1988). That document has been superseded by the *Facility Pollution Prevention Guide* (EPA/600/R-92/088, May 1992). The WMAC team at the University of Louisville performed an assessment at a plant that manufactures carbon and stainless steel products, primarily conveying and transportation equipment. Raw steel is cut, machined, welded into subassemblies, and sandblasted. Expanded metal is coated. All parts are painted, assembled, inspected, packaged, and shipped. The team's report, detailing findings and recommendations, indicated that the plant could achieve significant cost savings and waste reduction by replacing its current airless paint spraying system with a low pressure, airmix system.

This Research Brief was developed by the principal investigators and EPA's Risk Reduction Engineering Laboratory, Cincinnati, OH, to announce key findings of an ongoing research project that is fully documented in a separate report of the same title available from University City Science Center.

Introduction

The amount of waste generated by industrial plants has become an increasingly costly problem for manufacturers and an additional stress on the environment. One solution to the problem of waste generation is to reduce or eliminate the waste at its source.

University City Science Center (Philadelphia, PA) has begun a pilot project to assist small and medium-size manufacturers who want to minimize their generation of waste but who lack the in-house expertise to do so. Under agreement with EPA's Risk Reduction Engineering Laboratory, the Science Center has established three WMACs. This assessment was done by engineering faculty and students at the University of Louisville's WMAC. The assessment teams have considerable direct experience with process operations in manufacturing plants and also have the knowledge and skills needed to minimize waste generation.

The waste minimization assessments are done for small and medium-size manufacturers at no out-of-pocket cost to the client. To qualify for the assessment, each client must fall within Standard Industrial Classification Code 20-39, have gross annual sales not exceeding $75 million, employ no more than 500 persons, and lack in-house expertise in waste minimization.

The potential benefits of the pilot project include minimization of the amount of waste generated by manufacturers and reduction of waste treatment and disposal costs for participating plants. In addition, the project provides valuable experience for graduate and undergraduate students who participate in the program, and a cleaner environment without more regulations and higher costs for manufacturers.

Methodology of Assessments

The waste minimization assessments require several site visits to each client served. In general, the WMACs follow the proce-

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dures outlined in the EPA *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003, July 1988). The WMAC staff locate the sources of waste in the plant and identify the current disposal or treatment methods and their associated costs. They then identify and analyze a variety of ways to reduce or eliminate the waste. Specific measures to achieve that goal are recommended and the essential supporting technological and economic information is developed. Finally, a confidential report that details the WMAC's findings and recommendations (including cost savings, implementation costs, and payback times) is prepared for each client.

Plant Background

The plant manufactures carbon and stainless steel products, primarily conveying and transportation equipment. It operates approximately 2,040 hr/yr to process 1,500,000 lb of raw steel annually.

Manufacturing Process

The major raw materials used by the plant are stainless and carbon steel. Additional components used include pumps, wheel assemblies, controls and instrumentation, labels, and light assemblies.

Raw steel is cut by oxyacetylene gas torches, an automatic plasma system, or a water cutting system. Bending, drilling, turning, shaping, milling, punching, and sanding operations are performed as required. Machined parts are welded and sandblasted.

Expanded metal is coated with Penetrol (rust preventative) prior to joining raw steel parts in the paint area. Parts are wiped down, primed, and painted with an airless spray system.

Painted parts undergo final assembly where additional components are attached. These include pumps, assemblies, and instrumentation.

The finished product is inspected and shipped. An abbreviated process flow diagram is shown in Figure 1.

Existing Waste Management Practices

This plant already has taken the following steps to manage and minimize its wastes:

- Steel scrap is segregated by type and sold to a scrap dealer for recycling.
- A nonhazardous, biodegradable cutting fluid has replaced the previously used 1,1,1-trichloroethane-containing cutting fluid.
- The plant is working directly with a paint manufacturer to lower the barium concentration of the primer used.
- The plant has set a goal to become a limited or zero quantity generator by the first quarter of 1992.

Waste Minimization Opportunities

The type of waste currently generated by the plant, the source of the waste, the waste management method, the quantity of the waste, and the annual waste management cost for each waste stream identified are given in Table 1.

Table 2 shows the opportunities for waste minimization that the WMAC team recommended for the plant. The minimization opportunity, the type of waste, the possible waste reduction and associated savings, and the implementation cost along with the payback time are given in the table. The quantities of waste currently generated by the plant and possible waste reduction depend on the production level of the plant. All values should be considered in that context.

It should be noted that the economic savings of the minimization opportunity, in most cases, results from the need for less raw material and from reduced present and future costs associated with waste treatment and disposal. Other savings not quantifiable by this study include a wide variety of possible future costs related to changing emissions standards, liability, and employee health. It also should be noted that the savings given for each opportunity reflect the savings achievable when implementing each waste minimization opportunity independently and do not reflect duplication of savings that would result when the opportunities are implemented in a package.

Additional Recommendations

In addition to the opportunities recommended and analyzed by the WMAC team, several additional measures were considered. These measures were not completely analyzed because of insufficient data, minimal savings, implementation difficulty, or a projected lengthy payback. Since one or more of these approaches to waste reduction may, however, increase in attractiveness with changing conditions in the plant, they were brought to the plant's attention for future consideration.

- Employ galvanic or cathodic corrosion protection to eliminate the need for barium-based paint. Paint waste is currently considered hazardous because the barium level exceeds the allowable Toxicity Characteristic Leaching Procedure (TCLP) level.
- Purchase a chip wringer to remove tramp oil from small metal chips to prevent any future scrap metal recycling problems.
- Attach a drip board to the Penetrol dip tank to reduce lost dragout.
- Build an enclosure for steel storage or set up sediment traps with a weir system to eliminate storm water from washing oil off the steel and into the ground.
- Apply a polyurethane coat to the cement slab under the maintenance vehicle gas pump to prevent spillage from seeping through the cement and into the ground.
- Use a paint dipping system for expanded metal and rails to decrease the amount of paint overspray.
- Use a solvent recirculating paint gun washer.
- Give overpurchased paint to the community.
- Use a variable aperture paint gun to apply paint to the rails.
- Convince paint supplier to accept empty paint cans.
- Improve plant layout to facilitate efficient collection and segregation of wastes for recycle or pollution control.
- Use a centralized coolant sump for individual machining equipment.
- Skim and filter coolant, regularly clean the sump, and maintain the proper coolant-to-water ratio.
- Use acid treatment, ultrafiltration, centrifugation, coalescence, or evaporation for onsite treatment of coolant.
- Replace disposable paint booth filters with dissolvable styrofoam filters.
- Compact short metal scrap to reduce the cost of transporting to a recycler.
- Use sand waste as a raw material in manufacture of rock wool, as construction sand, or as an encapsulant for hazardous waste disposal.
- Sandblast in an enclosed or draped area to reduce dispersion of dust.

- Recycle empty sand bags.
- Investigate recycling of tires, pallets, batteries, and office trash.
- Clean rags onsite instead of using an outside laundry service.

This research brief summarizes a part of the work done under Cooperative Agreement No. CR-814903 by the University City Science Center under the sponsorship of the U.S. Environmental Protection Agency. The EPA Project Officer was **Emma Lou George**.

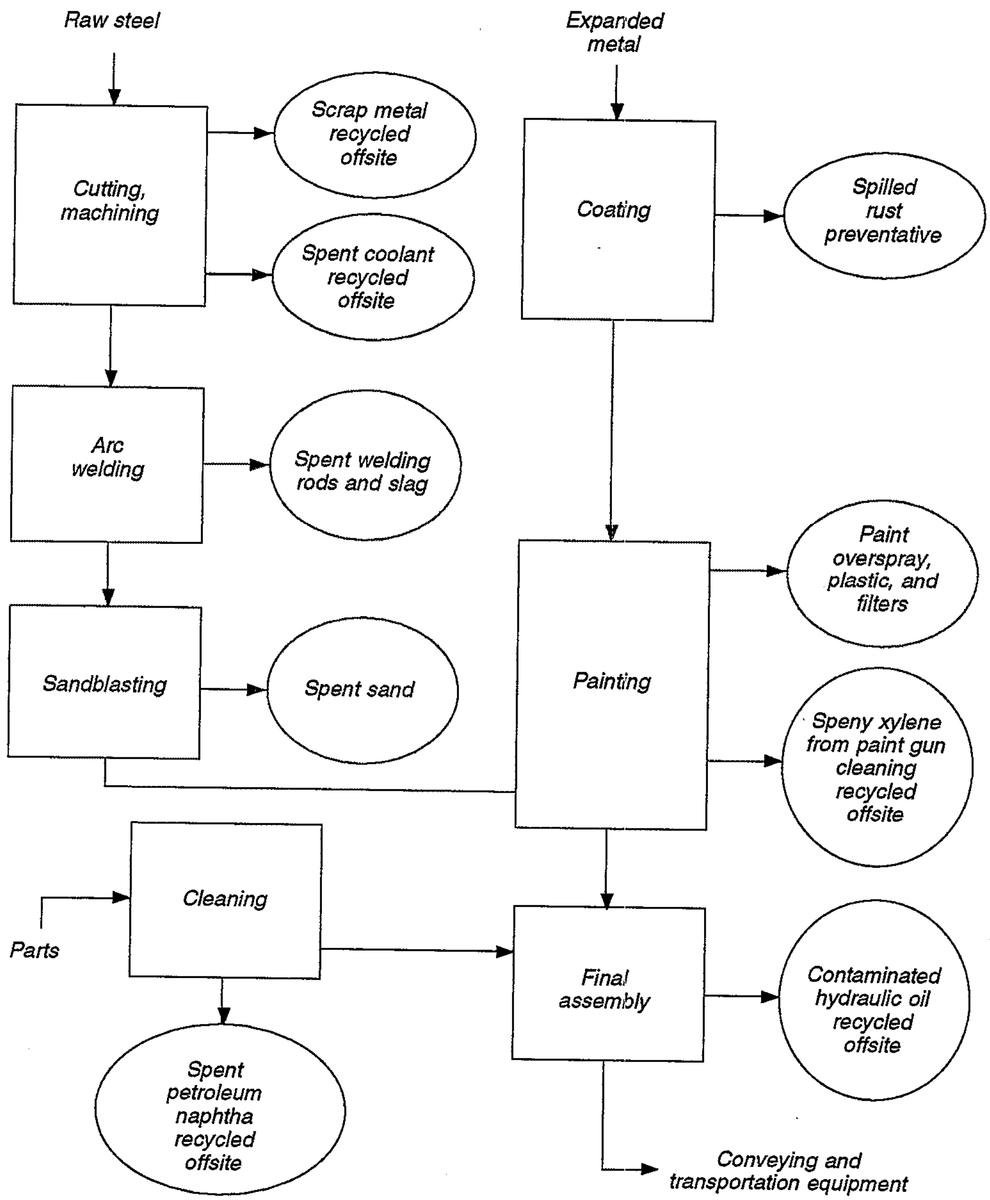

Figure 1. *Abbreviated process flow diagram for conveying and transportation equipment manufacture.*

Table 1. Summary of Current Waste Generation

Waste Generated	Source of Waste	Waste Management Method	Annual Quantity Generated (lb/yr)	Annual Waste Management Cost[1]
Scrap metal, paint cans	Machining, painting	Sold to metal recycler	420,000	-$17,160
Sand	Sandblasting	Shipped to nonhazardous landfill	3,650,000	55,030
Rags	Cleaning sandblasted parts	Laundered offsite	unknown	13,520
Paint wastes (overspray, filters, plastic sheets, rags)	Paint line	Shipped offsite as hazardous waste	6,000	6,000
General trash	Welding, packaging, and office activities	Shipped to nonhazardous landfill	1,500,000	18,300
Coolant	Machining	Shipped to waste oil reclaimer	9,600	3,720
Grease/sludge	Machining	Shipped to waste oil reclaimer	45	negligible
Petroleum naphtha	Cleaning of small parts	Reclaimed offsite by supplier	4,220	3,600
Hydraulic oil	Contaminated during assembly	Shipped to waste oil reclaimer	10,500	5,040
Motor oil	Vehicle maintenance	Shipped to waste oil reclaimer	19,440	1,470
Xylene and paint solids	Cleaning of paint guns	Offsite reclamation	4,750	2,550
Unused paint	Paint line	Shipped offsite as hazardous waste	195	1,200

[1] Includes waste treatment, disposal, and handling costs, and applicable lost raw material value.

Table 2. *Summary of Recommended Waste Minimization Opportunities*

Minimization Opportunity	Waste Reduced	Annual Waste Reduction		Net Annual Savings	Implementation Cost	Simple Payback (yr)
		Quanity (lb/yr)	Per cent			
Modify the paint spray system by using a low pressure, airmix system. Implementation of this opportunity would lead to reduced overspray.	*Paint wastes*	*2,000*	*50*	*$8,860*	*$12,000*	*1.4*
Replace the naphtha-based parts washer with a mechanical agitation system utilizing an aqueous biodegradable non-toxic detergent. The proposed unit should include an oil skimmer for oil removal; following skimming, the spent detergent solution can be sewered.	*Petroleum naphtha*	*4,220* [1]	*100*	*3,100*	*5,080*	*1.6*
Use di-basic esters instead of naphtha in the parts washer. Di-basic esters have a lower volatility than naphtha and are non-toxic, thereby lowering costs associated with evaporative losses and disposal. A di-basic ester waste stream will be generated if this WMO is implemented.	*Petroleum naphtha*	*4,220* [2]	*100*	*1,340*	*750*	*0.6*
Use cheese cloth pre-filters to cover currently used paint booth filters. Because cheese cloth is thinner than the filters, the volume of waste to be disposed of would decrease.	*Filters*	*1,240*	*71*	*1,110*	*0*	*0*
Recover spent paint gun cleaning solvent onsite using a batch distillation unit. A small quantity of still bottoms will be generated and shipped offsite for disposal if this opportunity is implemented.	*Xylene and paint*	*3,000*	*63*	*760*	*3,700*	*4.9*
Use an electrostatic precipitator and a filtering system to reclaim contaminated hydraulic oil onsite for reuse. A small quantity of residual dirt will be disposed of offsite if this WMO is implemented.	*Hydraulic oil*	*10,500*	*100*	*4,280*	*15,000*	*3.5*
Replace the coolant with a biodegradable and nonhazardous coolant. Purchase a ultrafiltration unit to remove oils so that the spent coolant can be discharged to the septic system. Oily residue will be shipped offsite if this WMO is implemented.	*Coolant*	*9,600*	*100*	*2,020*	*4,000*	*2.0*

[1] *A small quantity of spent detergent solution and skimmed oil will be generated.*
[2] *Waste di-basic ester (approximately 3,170 lb/yr) will be generated.*